State of Alaska
Department of Fish and Game
Nomination for Waters
Important to Anadromous Fish

1986
Year of Revision

86-232

Anadromous Water Catalog Volume Southeast Region I

USGS Quad Petersburg C-1

Name of Waterway Stikine River

Anadromous Water Catalog Number of Waterway
108-40-10150

Change to X Atlas
___ Catalog
___ Both

Addition ___
Deletion ___
Correction X

Name addition:
USGS name ___
Local name ___

ALASKA DEPT. OF
FISH & GAME
DEC 18 1985
REGION II
HABITAT DIVISION

For Office Use

Nomination # ___

Richard Reed 12/16/85
Regional Supervisor Date

[signature] 12/27/85

Tom Ruccio 12-27-85
Drafted Date

Species	Date(s) Observed	Spawning	Rearing	Migration
Eulachon (smelt)	See attached	X		X
	publication,			
	3/13-5/11/79			
	4/9 -5/15/80 +			
	annual observation 1981, 1982, 1983, 1984			

Comments: Provide any clarifying information, including number of fish observed, location of fish survey data, etc.

Add species to atlas. See attached paper for documentation

Attach a copy of a map showing location of mouth and upper points of each species, specific stream reaches identified for spawning or rearing, locations of barriers, such as falls. Attach a copy of the fish survey data, if available.

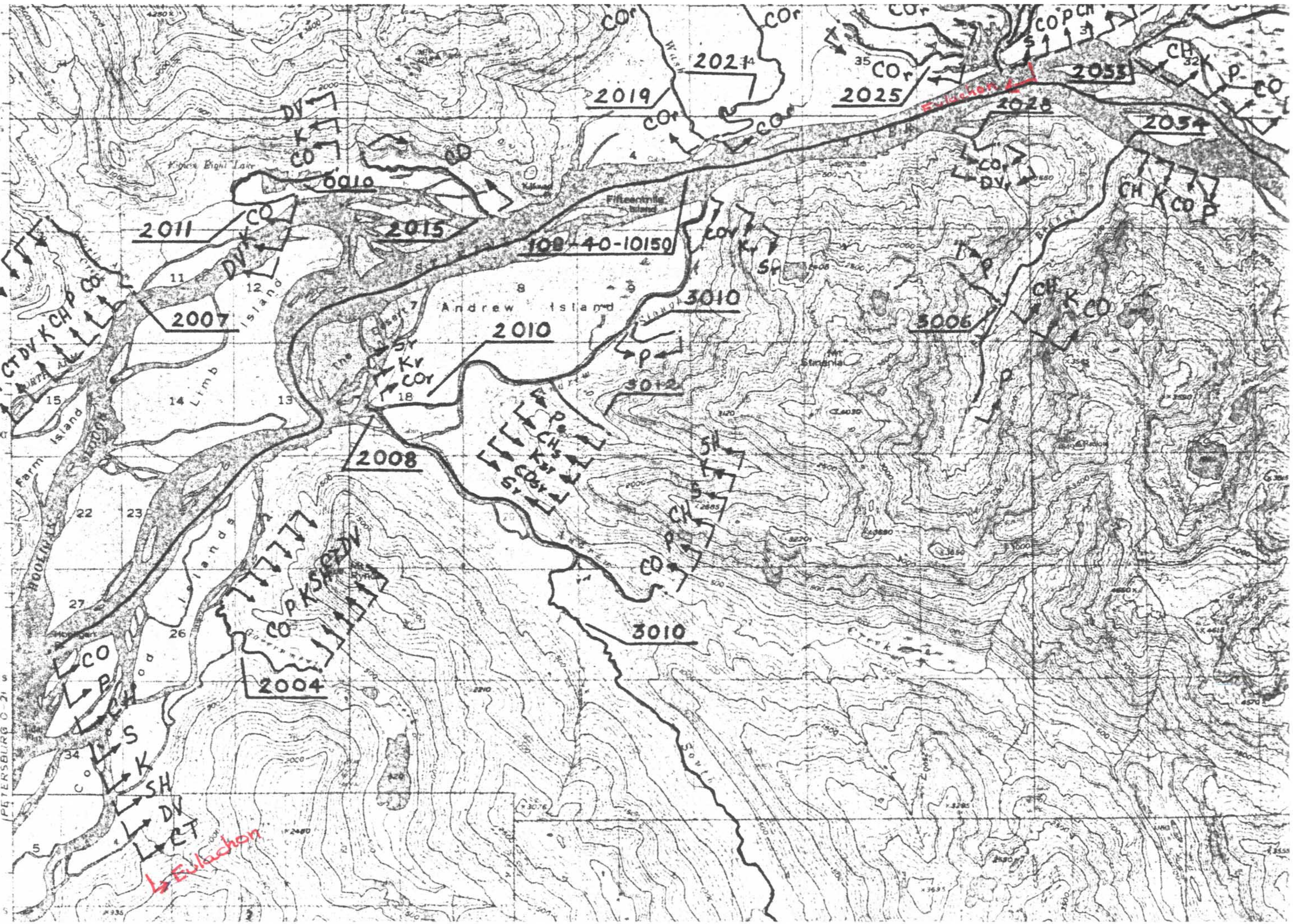
Name of Observer (please print) Brian L. Lynch

Date: 12/12/85 Signature: Brian L. Lynch

Address: Box 447
Petersburg, Ak 99833

Signature of Area Biologist: Don Cornelius

Petersburg
C-1



3

STIKINE RIVER EULACHON

(*Thaleichthys pacificus*)

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January 1981

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INTRODUCTION

Large concentrations of eulachon (Thaleichthys pacificus) migrate from the sea into the Stikine River to spawn during the spring. Eulachon are distributed on the west coast of North America from the Russian River in California, through Washington and British Columbia, to the Eastern Bering Sea and Pribilof Islands (Hart and McHugh 1944).

Historically, the Stikine River eulachon population played an important part of the early Indian economy which it served both as food and a source of fat. Eulachon are an important food source for many predatory animals including dogfish, sturgeon, halibut, cod, whales, sea lions, gulls, eagles, salmon, and seals.

Little is known about the life history of the eulachon in southeast Alaska. The major objectives of this study were to determine the distribution, upstream penetration, timing, sex ratios, fecundity, age structure, and average lengths and weights of the Stikine River eulachon population. Observations on some of the characteristics and habits of the population are described in this report. Studies on eulachon migration and life history have been conducted on the Columbia and Fraser Rivers (Smith and Saalfeld 1955, Hart and McHugh 1944). Information is sparce on the marine life history (Barraclough 1964) and the early life history and spawning behavior (Parente and Snyder 1970, Smith and Saalfeld 1955).

British Columbia Hydro is presently developing plans to dam the upper Stikine River and select tributaries. A major reason for studying the Stikine River smelt population was to gain a better understanding of the population in an effort to predict potential adverse impacts from hydro development.

Study Area

The mouth of the Stikine River is located approximately 7 miles north of Wrangell, Alaska, at latitude 56°30' N. and longitude 132°25' W. This survey was conducted from the mouth of the river to the U.S.-Canada border (Fig. 1), yet the majority of the watershed is located in the interior of British Columbia. Side channels, sloughs, and tributaries to the main Stikine were also examined. Tidal influence extends up the Stikine River to the Kakwan Point-Shakes Slough area.

MATERIALS AND METHODS

From 13 March to 11 May 1979, and 9 April to 15 May 1980, observations on the migration of the eulachon on the Stikine River were recorded. Observations included: migration timing; distribution; water temperature; sex ratios; spawning locations; physical characteristics of spawning locations; age; and length-weight relationships of the eulachon.

Gillnets were the primary sampling device used to determine times, locations, and relative abundance of the eulachon. During 1979, two different types of floating gillnets were used. One was 50 feet long by 8 feet deep and had

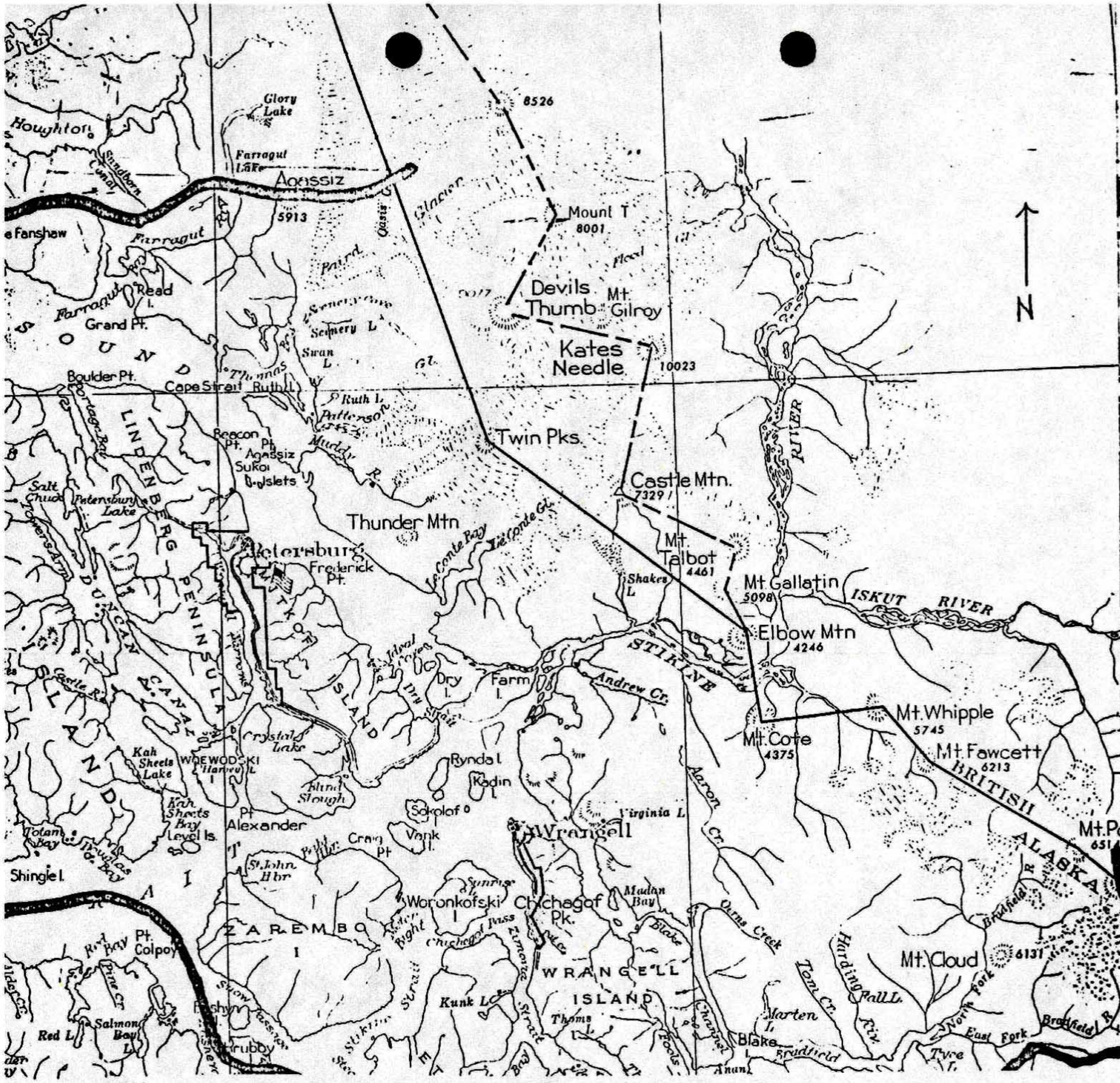

Figure 1. Area map indicating the survey location in relation to Wrangell and Petersburg, Alaska. Scale equals 1 inch to 12 miles.

1/2-, 1-, 1-1/2-, 2-, and 2-1/2-inch monofiliment stretch mesh panels. The second net was a 100 feet long by 8 feet deep multifiliment gillnet with 3/4-, 1-, 1-1/2-, and 1-3/4-inch stretch mesh panels. The net was dyed green. In 1980, both floating and sinking gillnets were initially used (Fig. 2).

Both nets were 100 feet long by 8 feet deep and contained two 50-foot panels of monofiliment netting, 1.5- and 1.25-inch stretch mesh size. The gillnets were worked from a 17-foot river skiff and set parallel with the current. The upstream end of the nets were anchored to the bottom of the river with Danforth anchors. Gillnets were soaked for 1 hour at each location when possible. The floats were removed from the floating gillnet when the sinking gillnet proved to be a significantly more efficient capture device.

At most locations, both gillnets were set within 100 yards of each other. Recorded at each location were exact location, weather conditions, depth of water, time soaked, water temperature in Fahrenheit, tide influence, color, flood stage, amount of floating debris, catch data, and any observations of fish, bird, or mammal activity in the area. Recorded under catch data were fish species, number of fish in each panel, sex ratio, the physical condition of the fish, and the location in the net where fish were captured.

A 25-foot beach seine was used to capture the smelt from which fork lengths, weights, and otoliths were collected. Beach-seined smelt were collected approximately 1 mile southwest of Binkley Slough, near Farm Island, on the tidal flats at low ebbing tide. Otoliths and scales were stored in scale envelopes for age determination which was conducted in the laboratory. A dissecting scope with the capability of 30 power magnification was used to determine the number of growth rings on the otoliths. The scales collected were unreadable because of their opaque color and reabsorption.

An Ekman model dredge was used to sample bottom substrates. An attempt was made to obtain one or more substrate samples at each gillnet set location, although samples were not obtained at all locations. Substrate samples were visually analyzed for presence or absence of eulachon eggs.

RESULTS AND DISCUSSION

Sampling Comments

The lower Stikine River and estuary present some unique sampling problems in terms of difficulties with ice, tide, organic debris, and river currents.

During the early part of the survey in both years, the Stikine River was frozen in the area located from Garnet Ledge to Binkley Slough (Farm Island) and about 3 miles above Grassy Island on the North Arm, all the way into Canada. Fishing was limited to the hour or two before maximum flood tide because the numerous finger channels in the lower intertidal area cannot be navigated by boat when the Stikine River discharge is low and the tide is out. As the tide flooded, large chunks of ice were forced up against the edge of the ice pack, and quickly moved out when the tide changed.

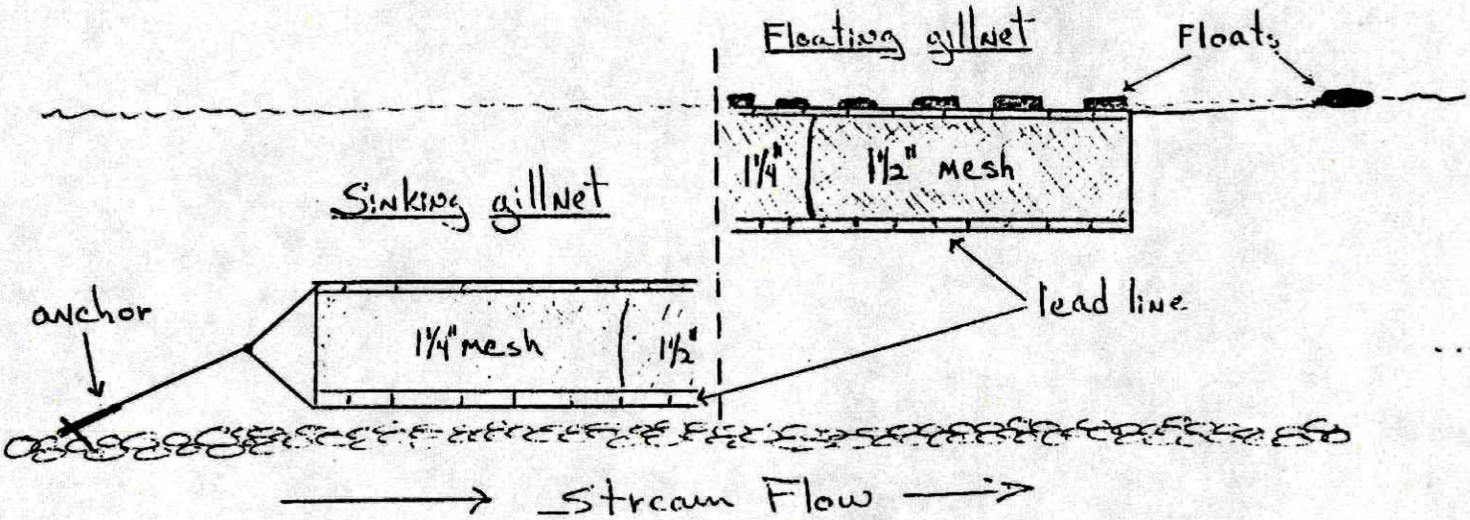

Figure 2. Cross section of stream illustrating the floating and sinking gillnets.

When the ice goes out on the river, large ice chunks begin moving down for a period which may last from several days to a week or more. This event coincided with the beginning of the smelt run in both years. The river begins to rise as the snow pack melts in the Stikine watershed. Water velocities increase dramatically. Tremendous quantities of leaves, fine organic debris, and logs move down the river presumably because areas within the flood plain are being flooded for the first time since the previous fall. Obviously, all of the above mentioned events seriously interfere with gillnetting.

Effect of Gillnet Mesh Size on Catch

In 1979, floating gillnets with different mesh size were employed to study the effect of mesh size on catch. Results are summarized below in Table 1.

Table 1. Effect of mesh size on catch.

	Stretch Mesh Size (inch)	Total Numbers Smelt
Net #1	3/4	12
	1	15
Multifiliment	1-1/4	246
	1-1/2	249
20 Foot Panels	1-3/4	13
Net #2	1/2	0
	1	2
Monofiliment	1-1/2	20
	2	9
10 Foot Panels	2-1/2	6

Fish captured in mesh sizes exceeding 1-3/4 inch were not gilled, but simply tangled. Smelt were almost always caught in the bottom few feet of the net. This was also true of the sinking nets employed in 1980.

Migration, Timing, Distribution and Catch Data

A total of 4,158 eulachon were captured in gillnets during the study. Locations of capture and catch per unit effort are indicated in Figures 3-6. Total catch per unit effort was 29.69 smelt captured per hour in 140.01 hours of gillnet soak.

The peak of the eulachon run in 1979 appears to have occurred near April 15, and prior to or near April 10 in 1980. By early May, the run is nearly over. Table 2 displays the catch data, sex ratios, and water temperatures for each year.

Table 2. Gillnet catch data of eulachon collected between March 13 and May 11, 1979, and April 9 and May 16, 1980, in the Stikine River, Alaska.

Date	Soak Hours	Total Catch	Catch per Hour	Sex Ratio (M:F)	Average Mean Temp. (F) at Sampling areas	Max. Temp. at Gauging Station (USGS)
March 13-15, 1979	8.25	0	0	-	34^{0}	33^{0}
March 26-28, 1979	13.4	2	.15	2:0	35^{0}	33^{0}
April 10-11, 1979	4.5	344	76.4	42:1	38^{0}	33^{0}
April 24-26, 1979	14.00	658	47.0	25.7:1	42^{0}	39.2^{0}
May 8-11, 1979	17.00	2	.12	2:0	45^{0}	40.1^{0}
April 9-10, 1980	7.84	1,180	150.51	5.6:1	36^{0}	N/A
April 16-20, 1980	29.98	1,795	59.9	26.2:1	36^{0}	N/A
May 1-6, 1980	15.00	91	6.1	2.7:1	43^{0}	N/A
May 12-15, 1980	24.74	86	3.47	7.6:1	46^{0}	N/A
Totals for both years	140.01	4,158		17.5:1	(weighted average)	

The discrepancy between the USGS river temperatures and the temperatures at the sampling areas is probably due partly to the tidal influence in the lower river. The USGS thermograph is located on the river's north bank below the Ketili River-Shakes Slough confluence with the Stikine, and may not be representative of the actual Stikine water temperature.

The relative change in run size between 1979 and 1980 could not be determined. Catch per hour data could not be compared for the respective years because different types of gillnets were employed.

The majority of the eulachon were spawning in the main river channels and sloughs. The various streams that are tributary to the Stikine were periodically visually examined for smelt. Water visibility was excellent. Smelt were not observed. High numbers of catch per unit effort in gillnets showed specific areas in the main channel where large numbers of eulachon were located (Figs. 3-6). These areas appear to be major spawning areas.

Dredge sampling was ineffective for locating egg concentrations. Dredge samples contained eulachon eggs at only one location at the mouth of Hooligan Slough. The water flow at this site was moderate, 8 feet deep with a substrate of course sand 1-2 millimeters in diameter. These spawning habitat characteristics in the Stikine River were found to be similar to the eulachon spawning locations described on the Columbia and Fraser Rivers (Smith and Saalfeld 1955, Hart and McHugh 1944). At other locations on the Stikine River where spawning habitat parameters were similar and eulachon were present, eggs

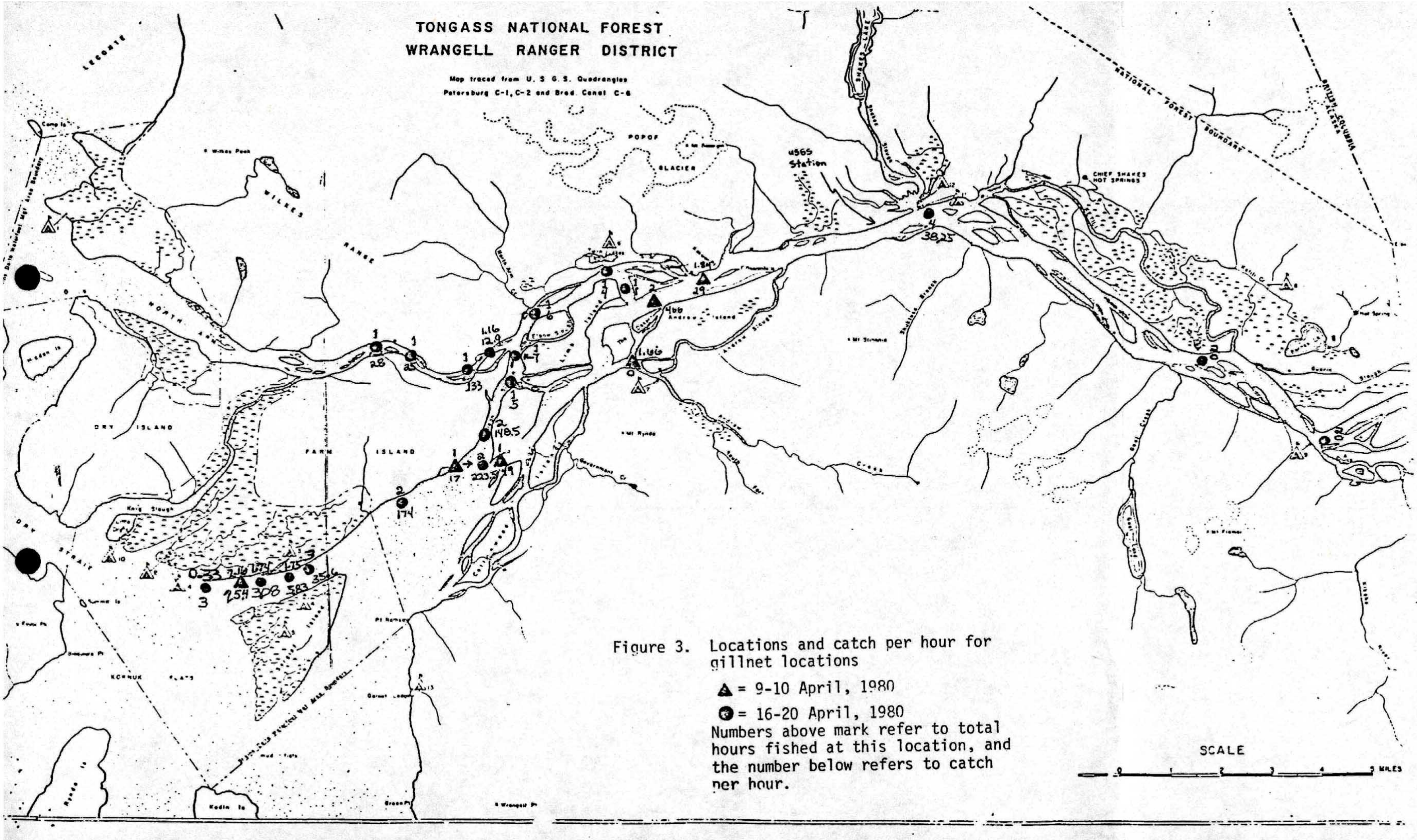

Figure 3. Locations and catch per hour for gillnet locations

▲ = 9-10 April, 1980

● = 16-20 April, 1980

Numbers above mark refer to total hours fished at this location, and the number below refers to catch per hour.

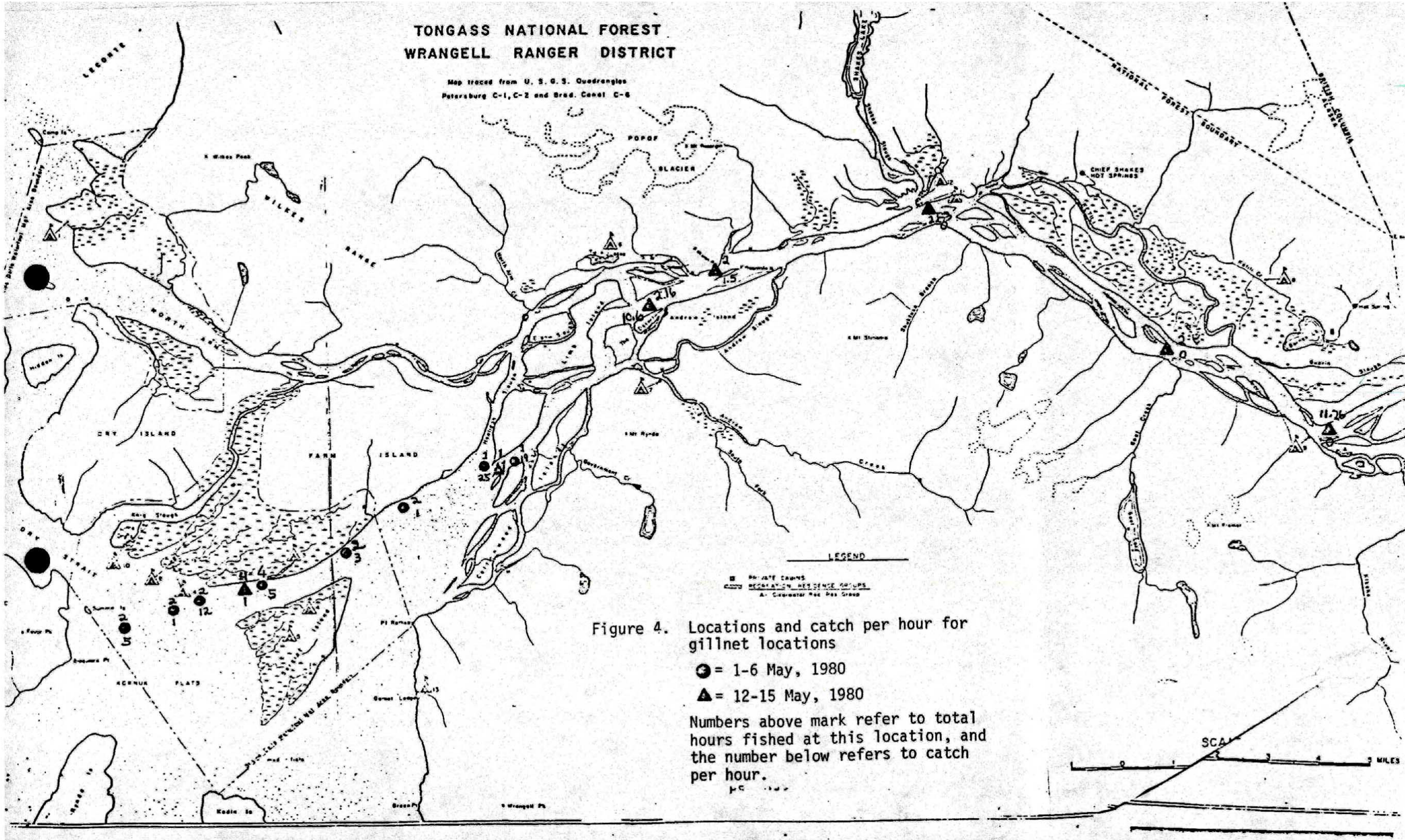

Figure 4. Locations and catch per hour for gillnet locations

● = 1-6 May, 1980

▲ = 12-15 May, 1980

Numbers above mark refer to total hours fished at this location, and the number below refers to catch per hour.

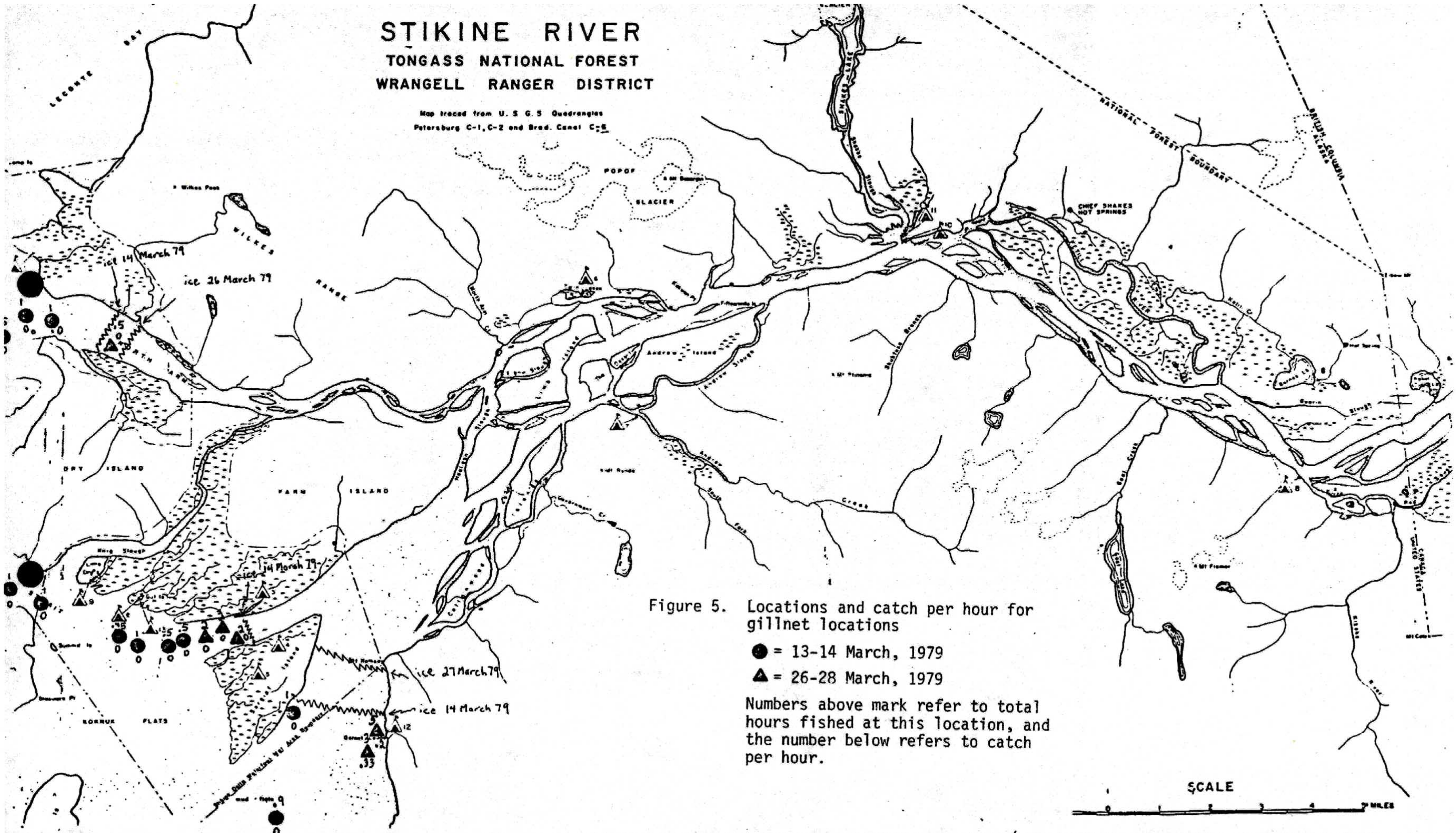

Figure 5. Locations and catch per hour for gillnet locations

● = 13-14 March, 1979

▲ = 26-28 March, 1979

Numbers above mark refer to total hours fished at this location, and the number below refers to catch per hour.

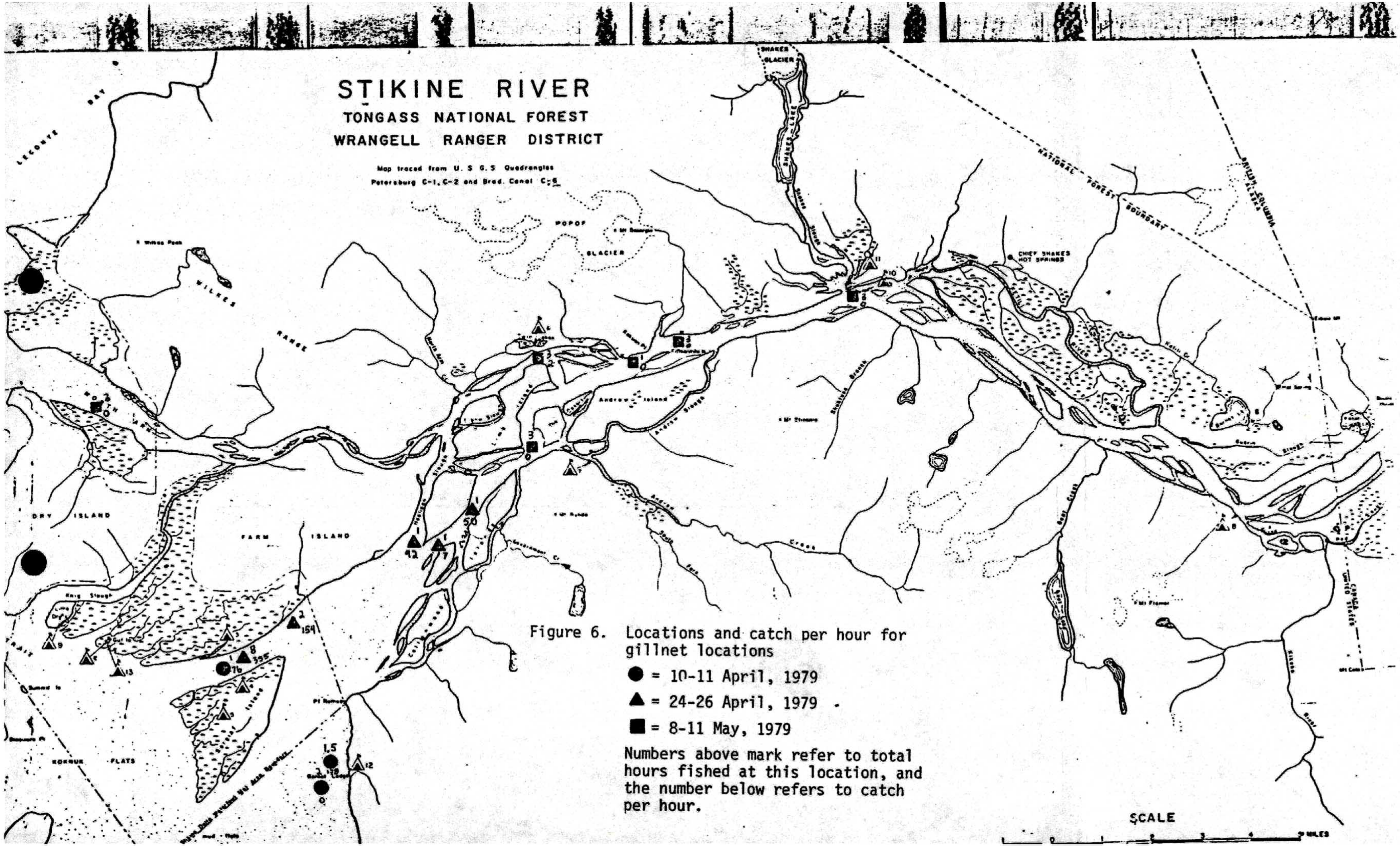

Figure 6. Locations and catch per hour for gillnet locations

● = 10-11 April, 1979

▲ = 24-26 April, 1979

■ = 8-11 May, 1979

Numbers above mark refer to total hours fished at this location, and the number below refers to catch per hour.

were not found in substrate samples. It is felt that this is due to the difficulty of retrieving the eggs in river current, visually identifying them, and possible low density in relation to the vast area.

Eulachon were captured upstream only to the confluence of Shakes Slough and the main river (Fig. 4). Numerous harbor seals (Phoca Vitulina) were observed throughout the study area.

Temperature Effects

Smith and Saalfeld (1955) found that the temperature of the water had a direct effect on migration and availability of eulachon in the Columbia River. Timing of the eulachon runs were found to correlate with temperatures around 39-40° F, normally in January. The Columbia River eulachon run would be delayed when temperatures were below 39° F and when temperatures exceeded 46° F.

The Stikine River water temperatures, measured at the catch locations and averaged daily, ranged from 35.5° to 46° F. The peak of the run occurs in early April at temperatures of 36° to 38° F (Table 2). Eulachon captured per unit effort declined as water temperatures increased. The eulachon run begins when water temperatures are lower than 36° F and appears to correspond with the breakup of ice. Eulachon were present in the river when the survey was discontinued on 11 May 1979 and 15 May 1980. Low concentrations of eulachon in May, reflected in catch per unit effort, may indicate the eulachon will continue to spawn in the Stikine River as temperatures exceed 46° F.

Sex Ratio

Average sex ratios ranged from 26.2:1 to 2.7:1 (males to females) throughout the survey (Table 2). Sex ratios for individual gillnet catches ranged as high as 422:1 (males to females). Commercial catch data reported from the Columbia and Fraser Rivers indicate that sex ratios will range between 12.3:1 to 3:1 with females occurring more frequently at the end of the run (Smith and Saalfeld 1955, Hart and McHugh 1944). An increased frequency of females captured near the end of the run was not observed in the Stikine River catch data. Interestingly, a sample of ocean-caught eulachon had only one female in 50 captured (Smith and Saalfeld 1955).

The reason for unequal sex ratios observed is not understood. Some possible explanations are: that the type of spawning may necessitate an excess of males (Smith and Saalfeld 1955); that there is selective mortality for females during the early life stages of development; or that the eulachon tend to segregate in the ocean environment. This last hypothesis suggests that females are homing to freshwater systems other than the Stikine River. The homing instinct has not been established for eulachon, although Smith and Saalfeld (1955) feel that irregularity of runs into various tributaries of the Columbia River precludes a home tributary influence.

Gillnet mesh size used for the capture of eulachon in the Stikine River was found not to bias the sex ratio observed (App. I). Interaction between the two gillnet mesh sizes and the relative numbers of males to females captured in the Stikine River was found to be insignificant (probability <0.01, App. I). Both gillnet and dip net catch on the Columbia River and its tributaries indicated a high discrepancy between males and females captured (Smith and Saalfeld 1955). Beach seine catch on the mouth of the Stikine River resulted in a sex ratio of 24:1 males to females.

Size and Age Structure

Means and standard deviations of gillnet and beach seine were compared to determine if capture gear was selective for size (Table 3).

Although there was no significant difference between weights and fork lengths in relation to gear type, gillnet-captured fish had a slightly larger standard deviation than seine-captured fish.

Table 3. Means and standard deviations of male and female eulachon captured in gillnets and beach seine (1980 only).

		Weight (g)		Fork Length (mm)	
	n	$\bar{x}$	s	$\bar{x}$	s
Gillnet (male	22	46.7	9.6	183.5	13.4
Seine (male)	112	45.7	7.9	186.3	8.9
Females (total)	8	44.3	9.6	184.6	13.2
Total:	142	46.0	7.5	185.7	9.8

The mean fork length of 3-year-old male eulachon captured on the Stikine River were found to be significantly larger than the Columbia River 3-year-old male eulachon by 15 millimeters (Table 4). This difference is most likely due to the productivity of the marine environment, although it may be due to genetic differences between the two populations.

Table 4. Fork length and weights of male eulachon in comparison to age on the Stikine River.

Year	Number in Sample	Age	Fork Length (mm) Range	Mean	Weight Range	Mean	% of Total
1979	20	2	141-197	180	18-50	38	14.1
1979	107	2	165-210	190	28-60	46	75.3
1979	15	4	173-213	194	34-58	52	10.6
1980	7	2	155-179	172	30-42	35	5.1
1980	126	3	162-208	186	32-60	46	91.3
1980	5	4	195-208	201	52-64	58	3.6

The respective selectivity of the different gillnet mesh sizes employed in 1979 and 1980 is felt to have very slightly biased the catch data.

In 1979, 1/2-, 3/4-, 1-3/4-, 2-, and 2-1/2-inch mesh gillnet were employed, where as in 1980, only 1-1/4- and 1-1/2-inch mesh were used. The 1/2-, 2-, and 2-1/2-inch mesh used in 1979 are of no real significance because the 1/2-inch mesh did not catch any fish, and fish were not gilled in the 2- and 2-1/2-inch mesh, merely tangled, irrespective of size. In 1979, only one fish smaller than 155 mm was caught (144 mm). The smallest fish caught in 1980 was 155 mm. By not employing 3/4 and 1 inch mesh in 1980, a very few fish that were smaller than 155 mm were probably not caught. The same logic could be applied to the 1-3/4-inch mesh used in 1979 for larger fish; but larger fish were caught in 1980 in 1-1/2-inch mesh, so this is also felt to be of minor significance.

Most of the male eulachon were found to spawn at 3 years of age, with a few spawning at 2 and 4 years (Fig. 7). The percentage of 2- and 4-year-olds was slightly higher in 1979 than in 1980. Age, fork length, and weight distributions observed on the Stikine River are similar to the reports from the Franser and Columbia Rivers (Smith and Saalfeld 1955, Hart and McHugh 1944).

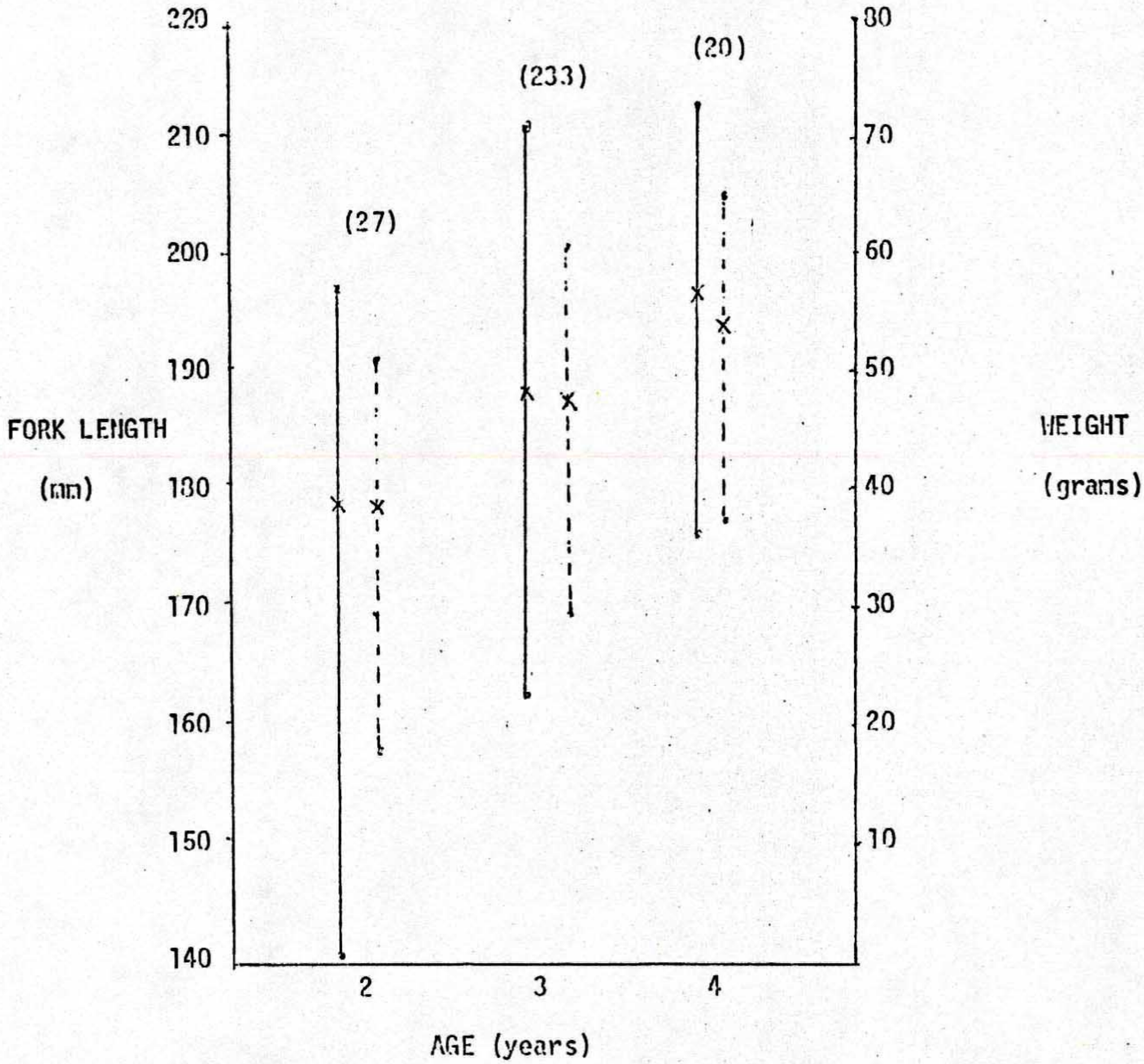

Figure 7. Ranges and means of fork length and weight in relation to the age of mature eulachon captured in the Stikine River, Alaska, during the springs of 1979 and 1980. Solid and dashed lines refer to fork length and weight, respectively. The frequency of samples are shown in parenthesis.

Fecundity

Fourteen gravid female eulachon were collected from the Stikine River for ova counts. A gravimetric subsampling technique was employed to determine fecundity levels (McGregor 1922). Fecundity rates were found to vary between 18,137 and 43,620 eggs per female. A positive correlation between fecundity and size of fish was observed (App. II.).

Commercial Value

Although catch data did not provide a population estimate or index, the Stikine River appears to support a large run of eulachon and may have commercial harvest potential. At present, a small subsistence and recreational fishery occurs primarily from residents living in Wrangell and Petersburg, Alaska.

Conclusions

1. The peak of the eulachon run occurred in early April in 1979 and 1980, and appears to be correlated with water temperatures and spring breakup. The run duration was observed to last 3 to 4 weeks.

2. The highest catch per unit effort occurred between Binkley Slough (Middle Arm) and Kakwan Point. It is felt that this area is the major spawning grounds for Stikine River smelt. Sampling effort was insufficient in the very lower part of the estuary, the North Arm, and the South Arm below Sergeif Island to comment about distribution. Sampling effort was also insufficient above Kakwan Point to precisely pinpoint upstream penetration, although based on limited upstream catch data and bird observations, it is felt that the limit is the Shakes Slough area.

3. Smelt were not observed in any tributary streams below the United States-Canada border.

4. Different types of fishing gear did not have a significant effect on the ratio of males to females captured. Sex ratios for 2 years of averaged gillnet data indicate a 17.5:1 ratio of males to females. Sinking gillnets with 1-1/4- and 1-1/2-inch stretch monofiliment mesh were the most effective gear.

5. The mean fork lengths of 3-year-old smelt on the Stikine River were found to be significantly larger than Columbia River 3-year-old smelt.

6. Fecundity rates of gravid female smelt varied between 18,157 and 43,620 eggs per female. A positive correlation was found between fork length and number of eggs.

7. The majority of the smelt are 3 years old when returning to spawn.

Potential Adverse Impacts from Upstream Hydro Development

The following is a brief summary of potential changes that may occur from upstream hydro development and affect the smelt population.

1. The preferred bottom substrate for spawning smelt appears to be course sands. Any decrease in the amount of sand or change in the present distribution of sand could affect the smelt population. Changes are likely if the Stikine's bedload, hydraulic conditions, or discharge regimes are altered.

2. The migration timing and hatching of the smelt is temperature dependent. Changes in the temperature regime of the main Stikine could adversely affect the smelt.

3. Predation of adult and juvenile smelt is associated with the turbidity of the river water. A decrease in suspended sediment may increase predation of smelt by gulls, seals, and piscivorous fish due to increased visibility. Newly hatched smelt are very feeble swimmers and are carried downstream to the estuary. A reduction in the spring and summer floods could also increase predation due to a longer exposure time.

Recommendations for Further Study

1. The extent of upstream penetration needs to be better defined.

2. Additional sampling on the North Arm, South Arm, and lower estuarine area is needed to better define overall smelt distribution.

3. More intensive sampling is needed in areas that appear to be the principle spawning areas to better define these areas and quantify bottom substrate particle size distribution.

Acknowledgements

Mr. Jeff Hughes, Ms. Kris Horosz, and Mr. James Hastreiter assisted in the data interpretation and project fieldwork. Their enthusiasm and hard work contributed greatly to the success of the project.

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